A NEW SPECIES OF LEUCOPHYLLUM (SCROPHULARIACEAE) AND COMMENTS ON RELATIONSHIPS OF THE GENUS

James Henrickson

Department of Biology California State University Los Angeles, California 90032, U.S.A. henrickson@mail.utexas.edu

ABSTRACT

Leucophyllum coahuilensis is described from a gypsum area in central Coahuila. Mexico. It is characterized by small, sessile leaves, a vestiture of dendritic hairs with long, slender radii, and blue to violet corollas with white on the throat floor with orange maculations. It is unique within the genus in having only 2 ovules per ovary. Recent cytological and molecular data regarding relationships between the Scrophulariaceae and Myoporaceae are discussed.

RESUMEN

Se describe a Leucophyllum coahuilensis como una especie nueva de suelos yesosos del centro de Coahuila. Se caracteriza por presentar las hojas pequenas y sésiles, un indumento de pelos dendritos con nadios largos y tenues, y las corolas de color violeta con la superficie interna abaxial de la garganta blancuzca o amarillenta con máculas anaranjadas. La nueva especie es la única del género que tiene dos óvulos por ovario. Se discuten datos citológicos recientes, y las relaciones del género con las familias Scrophulariaceae y Myoporaceae.

INTRODUCTION

Since the publication of the taxonomic monograph of *Leucophyllum* (Henrickson & Flyr 1985) two new taxa have been described (Nesom 1991, 1993) and a third new species is described herein. Additional information on chromosome numbers, anatomical features, and phylogenetic relationships have also been published and are summarized herein.

TAXONOMY

While traveling in central Coahuila on a recently paved highway from San Pedro de las Colonias to Laguna del Rey, I saw extensive, previously unexplored, outcroppings of gypsum. I drove to the slopes, parked my vehicle and within 50 feet found this distinctive new species of *Leucophyllum*.

Leucophyllum coahuilensis Henrickson, sp. nov. (Figs 1, 2). TYPE: MEXICO. COAHULA:N end of Valley of Acatita, 15.1 road mi N of Rancho Acatita where NE-SW running spur (Sierra del Cuchilla) extends to highway, the ridge containing extensive areas of gypsum; collections from the N side of this ridge; 26° 39N, 103°

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Fig. 1. Leucophyllum coaluilensis. A. Growth habit, the plant about 5 dm tall. B. Short shoot on young stem showing losse vestiture of dendritic hairs. C. Inflorescence showing post-flower calyces subtended by leaf-like bracts. D. Flower, lateral view, showing strongly vestitured calyx and spreading corolla lobes. E. Corolla, face view, showing posterior anthers and orange spots on the lower tube. Note hairs in lower throat and lower lobes. F. Corolla, face view, showing posterior stimm, internal spots and hairs on lobes and distal throat. B ~ 6 ($\propto 1.3$; D, $\propto 3$; E $\propto 4$; F $\times 4$.



Fig. 2. Leaf vestiture of Leucophyllum cochuilensis. A. Small leaf 3 mm wide, adaxial surface, showing loose vestiture of moderately branched hairs. B. Transverse section of leaf showing thickness of the vestiture in relation to the leaf thickness. C. Larger leaf showing tuft of straight hairs in abaxial base. Magnifications: bars = 1.0 mm.

10'W. 1070-1200 m. 20 Sep 1999, Henrickson 22601 with D. Riskind (HOLOTYPE: TEX: ISOTYPES: MEXU. NY, GH, US).

Frutices globosi, rami divergentibus, solum profundum gypseum incoli. Foha ovata ad elliptica, parva, sessilis, vestimento dendritico (cum radiis longis gracilibusque), sub pilis dendritici stipitari glandulosa, axillae foliorum cum caespitubus trichomatum indutae; corollae profunde caeruleopurpureae coloratae, cum coloribus luteis basi faucum, cum maculae aurantiaceae ad medium laucum, 10–13 mm longae. Fructus cum solis duobus seminibus instructus (non cum seminibus numerosae in fructo quocue, ut in caeteris speciebus generis).

Divaricately branched, broadly globose, densely vestitured, whitish shrubs 3-6 dm tall, 4-8 dm wide, becoming rather thorny due to retention of old divergent stems; young stems with long-shoot internodes 3-13 mm long, the internodes densely white pannose with short dendritic hairs and an overstory of scattered, slender, longer dendritic hairs, with a shorter series of nearly sessile stipitate glands; understory dendritic hairs with 3-5 short nodes, each with 1-4 radii, 0.2-0.35 mm long, the longer scattered emergent hairs somewhat cylindrical with the central axis somewhat zig-zagged, 0.8-1.2 mm long, with 6-10 nodes, the internodes 0.1-0.15 mm long, the radii 1-2 per node, 0.2-0.3 mm long; with age the longer vestiture weathering away to form a closer pannose vestiture that eventually is replaced as older stems develop a light grayish, weathered bark. Leaves alternate on long shoots, and crowded on axillary fascicles: leaf blades ovate, ovate-elliptical, elliptical to obovate, (3.5-)5-9(-12) mm long, (2.2-)3-5 (-7.6) mm wide, obtuse to rounded, sometimes acute at the tip, broadly cuneate to rounded at sessile bases, entire, flat or somewhat saddle shaped, with a white, loose, uniformly dense vestiture on both surfaces, the hairs dendritic, 0.7-1.3 mm long, with zig-zagged rachies with 3-7 nodes, with internodes 0.1-0.16 mm long, the radii 1-2 per node, 0.15-0.4 mm long, \pm 0.03 mm thick, the terminal arm often longest, the dendritic vestiture rather open, with the green leaf surface visible through the vestiture, with a close understory of stipitate glands 0.05-0.2 mm long, the basal adaxial surface leaves with a tuft of non-branched, white hairs 0.8-1.7 mm long. Flowers solitary in axils of the long-shoot leaves, on pedicels 1–4.7 mm long, \pm 0.25 mm thick, with a dense dendritic vestiture as on the stems; calvces 6-9.5 mm long, the 5 sepals separate to within 0.5 mm of the base, the sepals lanceolate to linear-lanceolate, attenuate, 6-8.5 mm long, to 0.8-1 mm wide, broadest in the middle and narrowing below, strongly dendritically vestitured outside with hairs to 1.5 mm long and with an understory of stipitate glands 0.05-0.2 mm long, the vestiture longer and more dense at the sepal base, the inner sepal surfaces green, with only scattered stipitate glands 0.1-0.3 mm long or also with scattered unbranched hairs; corollas strong blue to violet, with white-yellow at the tube base, and white with scattered orange-brown dots on the throat floor, the orange spots \pm 0.5 mm in diameter in several irregular series, the corollas 10-13 mm in total length (with lobes extended), the tube 7-8 mm long, to 4-4.5 mm wide at the distal throat, the 5

corolla lobes \pm equal in size and shape and spread, \pm oblong, broadly based. rounded at the tips, the upper 2 lobes (3.7-)4-5.5 mm long, 3.2-4.5 mm wide, the lower 3 lobes 4.2-6 mm long, 3-5.5 mm wide, the lobes spreading, often concavo-convex, the corollas moderately stipitate glandular outside with erect hairs to 0.1-0.3 mm long, the lower throat villous within with loosely arranged unbranched, wavy, white hairs 1-1.5 mm long that somewhat block the orifice to the throat; stamens 4, included, epipetalous; anthers white, each 2 lobed, the lower (anterior) 2 anthers 1.2-1.5 mm long (after anthesis), borne on free filaments 1-2 mm long, the adnate filament bases 3-5 mm long, the upper (posterior) anthers 1.7-1.8 mm long, borne on free filaments to 2-3 mm long, the adnate filament bases 3.2-6 mm long; ovary densely vestitured at the tip with erect, weakly branched hairs to ± 1 mm long, with the radii also erect; carpels and locules 2, ovules 1 per carpel produced in the distal fourth of the septa; styles 4.5-7.8 mm long, the stigmatic tip borne \pm at the distal corolla tube throat. beyond the anthers, sparsely pubescent throughout with scattered nonbranched hairs 0.2-0.3 mm long. Mature fruit and seeds unknown but ovoid immature seeds seen to 2 mm long, 1 mm wide.

Additional collections: **MEXICO. Coahuita**: ca. 31.5 rd mi S of Quimicas del Rey on paved road south to San Pedro de las Colonias, area of steep gypsum on E side of rd near 26° 42.N. 103° 10°W. Henrickson 2025G (TEX), N end of Valley of Acatita, 151 rd mi N of Rancho Acatta where NF-5W running spur (Sierra del Cuchilla) extends to highway, the ridge with extensive areas of gypsum, on solid gypsum interbedded with limestone, $\pm 26°$ 39N, 103° 10W, 20 Sep 1999. Henrickson 22604 with D. Riskind (TEX), W end of the Sierra de los Organos, 16 mi N of San Pedro (= Rancho Acatta) on Finisterre-Quimicas del Rey highway, in gypsum-limestone area, near 26° 39N, 103° 09W, ± 1150 m, 24 Sep 2002, Henrickson 23016 (TEX), same location, date. Henrickson 23025(TEX). All with duplicates to be distributed.

Leucophyllum coahuilensis is characterized by its small, sessile, ovate leaves. its dense, loose vestiture of dendritic hairs with moderately long rachis internodes (mostly 0.1-0.15 mm long) and few (1-2 per rachis node) thick radii mostly 0.2-0.3 mm long, 0.02-0.03 mm thick (Fig. 2). The sessile leaves also have a distinctive tuft of straight, unbranched hairs at the axil with the stem (Fig. 2C)-a feature not found elsewhere in the genus. All vestitured portions also have an understory of sessile or short-stipitate glands. This same vestiture also occurs on the pedicel and outer sepal surface. While the stems have a dense low understory vestiture that completely obscures the stem epidermis, the vestiture of the leaves is more open, with the green leaf surface clearly visible through the leaf vestiture, unlike some taxa, where the vestiture completely covers the leaf surface. The corollas are dark blue-violet with white marked with orange maculations in the lower throat; they are moderately short (10-13 mm in total length) and are stipitate glandular outside with a dense beard of wavy hairs on the basal throat within. The tip of the ovary has a dense beard of elongate branched hairs. Unlike all other species of Leucophyllum, ovules are only 2, one per carpel.

Within the genus *L. coahuilensis* is easily set apart by its two ovules per ovary, its distinctive vestiture, flower color, and sessile, ovate leaves with a basal tuft of unbranched hairs on the leaf axil. It appears most similar to *L. candidum* I.M.Johnston and *L. pruinosum* I.M.Johnston, both of which also have alternate leaves, orange maculations in the lower corolla throat, and vestitured ovary tips. The dendritic vestiture of *L. candidum*, however, has very short rachis internodes, with moderately long lower radii, and highly reduced upper radii, often not much longer than the width of the rachis internodes. As the terminal portions of the hairs fall away, the vestiture becomes very close and uniform (pannose), completely covering the leaf surface. *Leucophyllum candidum* also has petiolate, more broadly ovate, sometimes opposite leaves, and often larger flowers. It occurs from southern Big Bend Texas, eastern Chihuahua, through west-central Coahuila to northern Zacatecas and northeast Durango; its distribution surrounds that of *L. coahuilensis*, but *L. candidum* is not known from gypseous soils.

The new species is also somewhat similar to *L. pruinosum*, but the latter is distinguished by its vestiture that has longer, more slender radii (0.4–0.5 mm long, 0.01–0.015 mm in diameter); by petiolate, thinner, more orbicular leaves often with crisped margins; by more open, abruptly ampliate corolla throats; a preference for non-gypseous substrates; and a distribution around the confluence of the states of Tamaulipas, Nuevo León and San Luis Potosi (Henrickson & Flyr 1985).

The type locality of L coahuilensis lies about one half kilometer east of the payed highway between Química del Rey and the loop highway northwest of San Pedro de la Colonias, about 30.5 miles (51 km) south of Química del Rey and 52 miles (84 km) north of the turnoff from the loop road east of Finisterre. It is part of Ejido Río Aguanaval. The type locality lies on the northern slopes of a northeast-southwest running spur from the range (locally called the Sierra de Cuchilla) that extends from the main range towards the highway. The area contains areas of mixed gypsum and clay, and other areas of nearly pure gypsum where the new species is common. Associates in the area include both obligate gypsophiles: Fouquieria shrevei, Dyssodia gypsophila, Tiquilia gypsophila, Petalonyx crenulata, Dicranocarpus parviflorus, Nerisyrenia sp., Nama constancia, Haploesthes greggii, Euphorbia crepitata var. crepitata, Tiquilia gossipina, Selinocarpus purpusianus, Mentzelia mexicana, Drymaria elata, etc. and non-gypsophils: Grusonia braditiana, Jatropha dioica, Euphorbia antisiphilitica, Cordia parviflora, Castilleja lanata, Agave lecheguilla, Acacia neovernicosa. Allionia incarnata, Tiguilia greggii, Machaeranthera pinnatifida, Viguiera dentata, Tidestromia gemmata, Anulocaulis eriosolenus, Kallstromia erandiflora, and Larrea tridentata.

On all trips to the site, the plants always produced a few flowers but no

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mature fruit. I have concluded that the plants were idling, i.e., just producing a few flowers at a time, but not maturing seeds. Perhaps after periods of strong rainfall, the plants will flower more strongly and have the resources to set seed.

RELATIONSHIPS AND MORPHOLOGY OF THE GENUS

Evidence of a close phylogenetic relationship between *Leucophyllum* and the Myoporaceae has been presented from a cpDNA-based molecular phylogenetic study by Olmstead et al. (2001). In this study the Scrophulariaceae is separated into three distinct clades. *Leucophyllum* remained in their Scroph 1, or Scrophulariaceae senso stricto clade, showing a strongly supported relationship with Myoporaceae, with 100 percent bootstrap values and a high (44) decay value. Olmstead et al. (2001) suggested submersion of Myoporaceae into Scrophulariaceae s.s. along with the Loganiaceae. Robert Chinnock (pers. comm.), who has monographed *Eremophila* of the Myoporaceae, concurred and considered that Myoporaceae should be recognized as a subfamily of the Scrophulariaceae s.s.

In the monograph by Henrickson and Flyr (1985) the single chromosome count for *Leucophyllum* listed in Flyr's (1970) dissertation, obtained from pollen mother cells, was reported as both n = 15 and n = 16. The former number was a typographic error and the latter number may have been erroneous as well as Flyr (1970) indicated that he had difficulty in obtaining a clear chromosome spread. Read and Simpson (1989) reported x = 17 for *Leucophyllum* based on multiple root-tip counts from three species: *L.frutescens*, 2n = 34; L. minus, 2n = 34; and *L. candidum*, 2n = 68, the first two diploid; the latter a tetraploid. Thus the base number for the genus appears to be x = 17.

Within the Scrophulariaceae, x = 17 has been reported from some members of the Tribe Gratioleae, namely *Bacopa* Aubl. (2n = 68, Chandron & Bhavanandan 1981), *Limnophila* R. Br. (n = 17, 34; Chandrum & Bhavanandran 1986; Subramanian & Pondmudan 1987) and *Picrorhiza* Royle in Benth. (n = 17, Jee et al. 1987). A base number of x = 17 also has been reported for *Veronica* L. (tribe Digitaleae) along with x = 7, 8, 21, 32. Within the Scrophulariaceae base numbers range from x = 6-20 and some genera, as *Veronica*, show wide variation in base numbers.

Within the Myoporaceae, Barlow (1971) provided chromosome counts for 58 of the 214 species of the large genus *Eremophila* (Chinnock pers. comm.). All species were x = 18, with diploids, tetraploids, and hexaploids occurring. Only two other counts have been published for *Myoporum* are n = 54, presumably triploid numbers for *M. laetum* and for *M. laetum* var. *decumbers* (Hair & Beuzenberg 1959), and 2n = 68, a tetraploid based on x = 17, for *M. boninense* subsp. *boninense* by Ono and Masuda (1981). These are the only x = 17 counts recorded for the Myoporaceae thus far. Chinnock (pers. Comm.) considers the

Ono and Masuda (1981) count to be in error. A single count for *Bontia daphnoides* (Chinnock, pers. comm.) was n = 18. No counts are known for other genera of the family. The cytological data give little information of position of the genus.

Niezgoda and Tomb (1977) found that the Leucophylleae and Myoporaceae have tricolpate, diorate pollen grains of a distinct type not found elsewhere in the Sympetaleae. Karrfalt and Tomb (1983) further noted that the Myoporaceae are distinctive in having epithelium-lined secretory cavities in young stems and leaves. Their study showed that *Leucophyllum* has air cavities in the leaves that expand in a similar manner, although these lack epithelial linings and contents. They considered that the unlined air cavities of *Leucophyllum* may be homologous with the epithelial-lined secretory cavities in *Bontia* of the Myoporaceae. Lersten and Beaman (1998) found no support for the contention that air spaces in *Leucophyllum* were modified secretory cavities of the type found in Myoporaceae, however, they did find a single pair of epithelial-lined secretory cavities at the very leaf tips in three species of *Leucophyllum*. These did show a morphological similarity between *Leucophyllum* and Myoporaceae. Similar cavities are known from the genus *Capraria*, but its familial relation-ships are also under investigation (Lerston & Curtis 2001).

Carlquist and Hoekman (1986) studied wood anatomy of Myoporaceae and noted that certain xylem differences of *Leucophyllum* would exclude the genus from the Myoporaceae, but that there was a overall similarity of the woods of Myoporaceae and Scrophulariaceae as well as Gesneriaceae.

Commentson other species. Since publication of Henrickson and Flyr (1985) Guy Nesom has published two additional species of *Leucophyllum*. His *L. hintoniorum* Nesom from gypsum in the southeastern corner of Nuevo León, southeast of Aramberri (Nesom 1991) is distinctive in having a vestiture of three types of hairs: a very short understory of stellate-dendritic hairs that form a dense felty base layer; a larger series of stellate-dendritic hairs; and slender uniseriate gland-tipped hairs. With age the larger hairs fall alway leaving a closely pannose vestiture on both leaves and stems. The latter published *L. alejandrae* Nesom from a more arid gypsum area SW of Galeana, Nuevo León, about 68 km away, (Nesom 1993), has a similar vestiture, but narrower, more crowded leaves and smaller flowers. Subsequent collections of *L. hintoniorum* include specimens with much narrower, more crowded leaves, reducing the differences between the taxa. Unfortunately, *L. alejandrae* is known from only two collections, only one with flowers. More collections are needed of *L. alejandrae* in order to evaluate whether it should be considered separate from *L. hintoniorum*.

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